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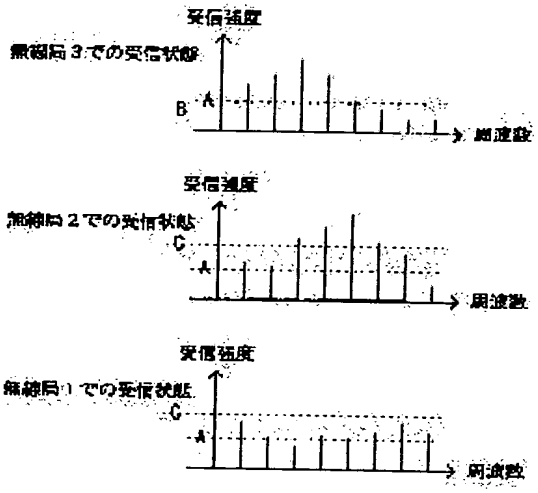
(54) SUB CARRIER ASSIGNMENT METHOD FOR WIRELESS COMMUNICATION SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a subcarrier assignment method for a wireless communication system by which a subcarrier providing a deteriorated reception state causing degradation in the transmission efficiency to a concerned wireless station cannot be assigned thereto.
SOLUTION: The method of this invention comprises a 1st step where a base station transmits reference signals consisting of subcarriers with an equal level to wireless stations at the same time, a 2nd step where the wireless stations inform the base station about the reception state by the subcarrier of each reference signal, and a 3rd step where the base station makes communications with destination wireless stations by means of packets in the transmission sequence depending on the reception state of each subcarrier. In the 2nd step, a 1st threshold A with respect to the reception strength is set, and a binary bit is used to express the reception state having the reception strength of the threshold A or over and having the reception strength smaller than the threshold A.



LEGAL STATUS

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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The subcarrier allocation method of a radio communications system of having the base station and one or more radio stations which multiplex a radio packet using two or more subcarriers, and communicate with this base station characterized by providing the following. The 1st phase where the aforementioned base station transmits the simultaneous reference signal of two or more subcarriers of ** level to the aforementioned radio station. The 2nd phase where the aforementioned radio station notifies the receiving state for every subcarrier of the aforementioned reference signal to the aforementioned base station. The 3rd phase of determining the subcarrier to which the aforementioned base station communicates with the transmission place radio station of a packet in order of transmission according to the receiving state for every aforementioned subcarrier.
[Claim 2] The aforementioned subcarrier is a method according to claim 1 characterized by being set as the transmission rate of the grade it can be considered that is flat phasing.
[Claim 3] the 2nd phase of the above -- the 1st threshold A of receiving intensity -- setting up -- the receiving state for every aforementioned subcarrier -- this -- the thing of the receiving intensity more than the 1st threshold A -- this -- the method according to claim 1 or 2 characterized by what is expressed with 1 bit binary [with the thing of receiving intensity smaller than the 1st threshold A]
[Claim 4] the transmission place radio station of the packet which should set up the 2nd threshold B of receiving intensity smaller than the threshold A of the above 1st, and the aforementioned base station should transmit first about the 2nd phase of the above -- this -- the method according to claim 3 characterized by notifying the identifier of the subcarrier of receiving intensity smaller than the 2nd threshold B to this base station
[Claim 5] the transmission place radio station of the packet which should set up the 3rd threshold C of larger receiving intensity than the threshold A of the above 1st, and the aforementioned base station should transmit to 2nd henceforth about the 2nd phase of the above -- this -- the method according to claim 3 characterized by notifying the identifier of the subcarrier of larger receiving intensity than the 3rd threshold C to this base station
[Claim 6] The method according to claim 1 or 2 characterized by expressing the aforementioned receiving state with the amount of information of two or more stages, and notifying only a changed part with the receiving state for every former aforementioned subcarrier to the aforementioned base station about the 2nd phase of the above.
[Claim 7] The method according to claim 6 that a changed part of the aforementioned receiving state is characterized by what is expressed with several binary bits.
[Claim 8] The method according to claim 6 or 7 characterized by notifying collectively the information "there is much change" to the aforementioned base station, without notifying a changed part of the receiving state for every aforementioned subcarrier when a changed part of the aforementioned receiving state is more than fixed level.
[Claim 9] The aforementioned subcarrier is a method given in any 1 term of the claims 1-8 characterized by being a sub band containing two or more these subcarriers.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the subcarrier (or sub band) allocation method of a radio communications system.
[0002]
[Description of the Prior Art] Drawing 1 is the block diagram of the target radio communications system. This system has a base station and one or more radio stations which multiplex a radio packet using two or more subcarriers, and communicate with this base station. As shown in drawing 1 , it gets down from the solid line with an arrow, and the dashed line with an arrow expresses the uphill signal (signal from a radio station to a base station) for the signal (signal from a base station to a radio station).
[0003] Conventionally, the point-to-multipoint connection method in a radio communications system is realized by Frequency Division Multiplexing (FDMA), Time Division Multiplexing (TDMA), sign division multiplex (CDMA), or such combination (hybrid). Two or more these divided elements are prepared as a channel, and it connects concurrently by assigning each to each radio station. That is, two or more radio channels discriminated with different frequency, a time [to differ] slot, or a different diffusion sign are prepared, and it assigns each radio station.
[0004] In a base station, the frequency band assigned to the base station is divided equally in principle, and a carrier (subcarrier) is prepared. For example, about 40 FDMA/TDMA carriers can be prepared at intervals of 25kHz out of a 1MHz band, or four CDMA carriers can be prepared at intervals of 5MHz out of a 20MHz band.
[0005] Moreover, the carrier frequency of the radio channel which the base station assigned to the radio station is not changed during communication with the same base station in principle. That is, specific frequency is continued and used regardless of instant change of the frequency characteristic of the propagation path produced with movement of a radio station.
[0006] Here, the conventional technology of radio packet transmission using multi-carrier transmission is explained.
[0007] OFDM is a method which transmits a signal by two or more subcarriers, and ground digital broadcast or use by high-speed wireless LAN is planned. Generally, a subcarrier is set as the transmission rate (they are about 10 kspses in outdoor environment) of the grade it can be considered that is flat phasing. In order for addressing to 1 user to get down and to transmit a signal using all subcarriers, there is a fault in which a transmission efficiency deteriorates by the bad subcarrier of a receiving state in each radio station.
[0008] Characterization etc. is advanced about the high-speed packet transmission using MC-CDMA now (for example, Abe rice field Sadayuki et al. and "property comparison of SC/DS-CDMA [in / link broadband radio packet transmission / it gets down and], MC/DS-CDMA, and MC-CDMA method" electronic-intelligence communication society Shingaku Giho, and RCS99-October, 1999 / 130 or / etc.). Since the spread spectrum of each subcarrier is carried out, the occupancy band is large, and since frequency-selective phasing is generally received, dispersion in the receiving state of a subcarrier decreases.
[0009] Drawing 2 is the conventional method of transmitting one by one from a packet with the Request to Send. The number described at each packet is the radio station number of the partner who transmits a packet. The packet to a radio station 3 is in a head, and the packet of radio station 4 ** has become the last. This method has the feature in the point transmitted without multiplexing a radio packet. In a radio station, the header of the radio packet currently transmitted is seen and it judges whether it is the packet of ******. In the radio station of a radio packet sending-out place, if a packet is received correctly, ACK will be returned. About the radio packet to which ACK did not return, you may carry out resending control. Moreover, to the radio station judged to be good, more efficient transmission of a radio circuit is also attained from ACK information using multi-level modulation by next transmission (adaptation modulation technology).
[0010] Drawing 3 is the conventional method of multiplexing and transmitting a packet to two or more ********, when transmitting using a spread-spectrum signal. Since each radio packet is multiplexed with a different diffusion sign, it does not necessarily perform assignment according to the receiving state. Moreover, in MC-CDMA, in order to expect the effect of path diversity and to set up the occupancy band of a subcarrier widely, generally the difference of the receiving state of a subcarrier becomes small.
[0011]
[Problem(s) to be Solved by the Invention] However, each conventional method has the problem that it assigns even if a base station is the bad subcarrier of a receiving state for the radio station concerned. By the method of drawing 2 , since the good subcarrier of a receiving state and a bad subcarrier are intermingled and are assigned when

assigning two or more subcarriers, the transmission efficiency as the whole will deteriorate. Moreover, by the method of drawing 3 , the occupancy band of a subcarrier is large, and since the good portion of a receiving state and the bad portion are intermingled, the transmission efficiency as the whole will deteriorate like drawing 2 .
[0012] Then, this invention aims at offering the subcarrier allocation method constituting the cause of degradation of a transmission efficiency which does not assign a subcarrier with a receiving state bad for the radio station concerned in a radio communications system.
[0013]
[Means for Solving the Problem] Therefore, the subcarrier allocation method of the radio communications system of this invention The 1st phase where a base station transmits the simultaneous reference signal of two or more subcarriers of ** level to a radio station, It has the 2nd phase where a radio station notifies the receiving state for every subcarrier of a reference signal to a base station, and the 3rd phase of determining the subcarrier to which a base station communicates with the transmission place radio station of a packet in order of transmission according to the receiving state for every subcarrier. As for a subcarrier, it is desirable to be set as the transmission rate of the grade it can be considered that is flat phasing.
[0014] according to the 1st operation gestalt of this invention -- the 2nd phase -- the 1st threshold A of receiving intensity -- setting up -- the receiving state for every subcarrier -- this -- the thing of the receiving intensity more than the 1st threshold A -- this -- it is desirable to express with 1 bit binary [with the thing of receiving intensity smaller than the 1st threshold A]
[0015] the transmission place radio station of the packet which according to the 2nd operation form of this invention should set up the 2nd threshold B of receiving intensity smaller than the 1st threshold A, and a base station should transmit first about the 2nd phase -- this -- it is also desirable to notify the identifier of the subcarrier of receiving intensity smaller than the 2nd threshold B to this base station
[0016] the transmission place radio station of the packet which according to the 3rd operation gestalt of this invention should set up the 3rd threshold C of larger receiving intensity than the 1st threshold A, and a base station should transmit to 2nd henceforth about the 2nd phase -- this -- it is also desirable to notify the identifier of the subcarrier of larger receiving intensity than the 3rd threshold C to this base station
[0017] According to the 4th operation gestalt of this invention, it is also desirable to express a receiving state with the amount of information of two or more stages, and to notify only a changed part with the receiving state for every former aforementioned subcarrier to the aforementioned base station about the 2nd phase. It is also desirable for a changed part of a receiving state to be expressed with several binary bits, and to notify collectively the information "there is much change" to a base station, without notifying a changed part of the receiving state for every subcarrier, when a changed part of a receiving state is more than fixed level. Thereby, the amount of information which should be notified can be reduced.
[0018] As for a subcarrier, according to other operation gestalten of this invention, it is desirable that it is also a sub band containing two or more these subcarriers. Thereby, the amount of information which should be notified can be reduced.
[0019]
[Embodiments of the Invention] Below, the operation gestalt of this invention is explained in detail using a drawing.
[0020] this invention assigns a subcarrier in a base station based on a report of the receiving state from a radio station, and the transmitting traffic to each radio station. Each subcarrier can also assign one subcarrier to two or more radio stations below, if the spread spectrum of the subcarrier is carried out, although explained as what is assigned only to one radio station.
[0021] However, when the occupancy band of each subcarrier has frequency selection, it is desirable to narrow the occupancy band of a subcarrier to the grade which can disregard frequency selection. That is, the occupancy bandwidth of a subcarrier is set below to a coherence bandwidth grade.
[0022] Drawing 4 is explanatory drawing showing the sequence to which the Request-to-Send packet arrived at the base station. At this time, a base station chooses partly the transmission place radio station of the packet which should transmit from a top packet, and requires a report of a receiving state from these radio stations. Here, the transmission place radio station of the packet which should transmit has occurred in order of 3, 1, and 2.
[0023] Drawing 5 is the graph of the frequency-transmitting intensity of the reference signal transmitted from the base station by this invention. the subcarrier top which a base station asks for a report of a receiving state -- intermittence -- or a reference signal is transmitted continuously This reference signal may be the signal with which the transmit data was modulated, or a pilot signal which consisted of known patterns. At drawing 5 , the reference signal of eight subcarriers is transmitted on ** level simultaneous.
[0024] It is divided into the frequency band which can receive strongly, and the frequency band which is not so by frequency selection, so that it gets down and a signal becomes broadband transmission. This frequency selection changes with transmission-line states between a base station and a radio station.
[0025] Drawing 6 is the graph of the frequency-receiving intensity of the reference signal in three radio stations which received the reference signal of drawing 5 . The 5th subcarrier is received in a radio station 3, and the circumference is strongly received for the 3rd subcarrier circumference in the radio station 2. Moreover, in the radio station 1, the 1st and the 7th subcarrier are received on the level which is the same grade.
[0026] Drawing 7 is explanatory drawing of the receiving status-report signal in the 1st operation gestalt of this invention, and assignment of a subcarrier. It reports to a base station whether the receiving intensity of each subcarrier has exceeded the radio station to the threshold A of a receiving state. In addition, a radio transmission

sets Threshold A as the receiving intensity which can be performed with quality sufficient enough.
[0027] According to drawing 7 , assignment of a subcarrier is performed sequentially from the transmission place radio station of the top packet which should transmit. As for the top packet which transmits to a radio station 3, the subcarriers 1-5 with strong receiving intensity are assigned in the radio station 3 concerned. Next, the subcarriers 6 and 7 with strong receiving intensity are assigned in the radio station 2 concerned among the subcarriers to which the 2nd packet which transmits to a radio station 2 is not assigned yet. Finally, since the 3rd packet which transmits to a radio station 1 has the strong receiving intensity of the remaining subcarriers 8 in the radio station 1 concerned, it assigns this. Thus, three radio packets are multiplexed sequentially from a top packet in consideration of a receiving state.
[0028] Drawing 8 is explanatory drawing of the receiving status-report signal in the 2nd operation gestalt of this invention, and assignment of a subcarrier. To the radio station which is a top packet sending-out place, the threshold B smaller than A is set up further, and the subcarrier which is less than Threshold B is notified to a base station. The threshold B here means that receiving intensity is weak.
[0029] According to drawing 8 , about the transmission place radio station 3 of a top packet, the same threshold A as drawing 7 is used [radio stations / 2 and 1] using Threshold B. About a radio station 3, it turns out that subcarriers 7 and 8 are less than Threshold B. Therefore, as for the top packet which transmits to a radio station 3, the subcarriers 1-6 whose receiving intensity is not weak are assigned in the radio station 3 concerned.
[0030] With the 1st operation gestalt, since it ends by 6 bits (= subcarrier number triplet x2 **) with the 2nd operation gestalt to having been required for the notice of a receiving state of a radio station 3 8 bits, the amount of transmissions required for a report of the receiving state from a radio station can be reduced. Thus, with the 2nd operation gestalt, by giving priority to and multiplexing a top radio packet by two thresholds A and B, head packet transmission delay can be shortened and the amount of transmissions to the subcarrier which is less than the threshold B which cannot expect sufficient transmission can be reduced.
[0031] Drawing 9 is explanatory drawing of the receiving status-report signal in the 3rd operation gestalt of this invention, and assignment of a subcarrier. To the radio stations 1 and 2 which are the sending-out places of the packet of the 2nd henceforth, the larger threshold C than Threshold A is set up, and the subcarrier number exceeding Threshold C is notified in radio stations 1 and 2. Like the 1st and 2nd operation gestalten, although each subcarrier is assigned based on a receiving state table, it assigns the radio station 3 which is the destination of a head packet about a ******** subcarrier (the example of drawing 9 subcarrier 8).
[0032] While shortening head packet transmission delay by giving priority to and multiplexing a top radio packet by two thresholds A and C according to drawing 9 , the expected value of the number of subcarriers to which Threshold C exceeds this since it is large is low, and the effect of reducing the amount of transmissions required for the notice of a receiving state from a radio station can be expected. For example, the amount of information which the notice of radio stations 2 and 3 took is 16 bits with the 1st operation gestalt to being 12 bits with the 3rd operation gestalt.
[0033] With the 1st to 3rd operation gestalt, although the receiving state is notified by binary condition (O or x) on the basis of one threshold (A, B, or C), it may be notified with the number of states exceeding binary, of course of two or more step story. In this case, although the amount of information for a notice increases, assignment of a more efficient subcarrier is attained.
[0034] In order to notify a quota result to each radio station from a base station, it assigns by the information channel and information is notified. An information channel may use all or a part of subchannel explained here by time sharing or sign division, and may be a completely different channel. In each radio station, the allocation information from a base station can be received and a desired signal can be acquired by restoring to the subcarrier assigned to the local station.
[0035] Drawing 10 is the graph of the frequency-receiving intensity at the 2 time of the reference signal for explaining the 4th operation gestalt of this invention. Drawing 11 is a receiving status-report signal-description view corresponding to 2 time of drawing 10 , respectively. Here, the receiving state in each time is notified by the three-stage. The 4th operation gestalt is the method of notifying only a changed part of a receiving state to a base station.
[0036] It will be necessary to transmit two or more packets continuously depending on the size of a packet. Moreover, since the receiving state in the radio station under movement changes every moment, the periodical receiving status report from the partner radio station which transmits a radio packet continuously is needed. Therefore, since there is also little change of a receiving state in a mobile station with little movement magnitude, the amount of information for a notice is reducible by notifying only a changed part with the report information on the last.
[0037] Amount of information required in order for a three-stage to report the receiving state of eight subcarriers becomes 8xlog2(3) =12.7 bit. On the other hand, a changed part of a receiving state is encoded as follows, for example. It is referred to as "11", when changeless, there is change of "00" and + and there is change of "10" and -. If it does in this way, the receiving state of drawing 11 can be transmitted by 10 bits (=(subcarrier number triplet + change 2 bits per part) x2 **), and the amount of information for a notice can be cut down.
[0038] Moreover, it is effective, when change of a receiving state is below fixed level and notifying "with no change" collectively, without notifying each receiving state also cuts down amount of information.
[0039] what averaged total of the absolute value of the variation ("difference with last time" of drawing 11) of for example, a receiving state by one subcarrier with change of a receiving state here -- or correlation between

receiving on-the-strength waves as shown in drawing 10 etc. can be considered
[0040] When change of a receiving state is large, the effect is scarce, even if it is necessary to notify the receiving state for every subcarriers of all and uses the curtailment method of above-mentioned notice information. In this case, when change of a receiving state is more than fixed level, it can also notify "There is much change" collectively. It is thought that the receiving state which carried out the time average since each subcarrier at this time had received big time variation for all may assign arbitrary subcarriers since every subcarrier becomes of the same grade. In addition, as for this method, it is desirable not only a report of the continued receiving state but to apply in the 1st receiving status report.
[0041] Although the 1st to 4th operation form reports a receiving state per subcarrier, it is also desirable to perform this in the unit of the sub band (frequency band) with which two or more subcarriers are contained. Thereby, the amount of information for the notice of a receiving state is cut down. The receiving state of a sub band is in the average or typical receiving state searched for from the receiving state of one or more subcarriers belonging to the sub band.
[0042] Drawing 12 is the graph of the frequency-receiving intensity of the sub band allocation method. Here, when the number of subcarriers is 24, one sub band is formed every four subcarriers. Thereby, the amount of information of the receiving state which should be notified is set to one fourth.
[0043] If the bandwidth of a sub band is below a coherence bandwidth grade, even if it reports a receiving state per sub band, there will be no big degradation. Assignment of the subcarrier in that case may be put in block per sub band, and may be performed.
[0044] If the bandwidth of a sub band is beyond a coherence bandwidth grade, complement presumption of each subcarrier or the receiving state of a coherence band will be carried out from the receiving state of two or more adjoining sub bands, and assignment with frequency efficiency with it more sufficient [to perform radio assignment in the unit of a subcarrier or a coherence band] can be performed.
[0045] according to the operation form of the subcarrier allocation method of this invention mentioned above, various relation between a receiving status-report signal and assignment of a subcarrier can also be considered, and according to this contractor, various change of the technical thought of this invention and the range of a standpoint, correction, and an abbreviation can be performed easily The above-mentioned explanation is an example to the last, and it is not going to restrain it at all. this invention is restrained by only what is limited as a claim and its equal object.
[0046]
[Effect of the Invention] As mentioned above, since a packet is multiplexed using a subcarrier with strong receiving intensity for every radio station according to the subcarrier quota method of the radio communications system of this invention as explained in detail, compared with the conventional technology which carries out packet transmission, using all subcarriers equally, a going-down signal transmission with sufficient frequency efficiency is attained.

[Translation done.]